

Reports from the headwaters of the Columbia and Snake rivers are to the effect that there was more snow in the mountains at the end of March than usual. The snow came early and was heavy during December and January, but light in February and March. It packed solid early in the season which insures slow melting, and abundant water for irrigation purposes is anticipated during the coming spring and summer in eastern Oregon, eastern Washington, and Idaho.

The annual rise in the lower Columbia River depends largely upon the temperatures during April and May. There is always snow enough in the mountains to cause a flood, provided it melts quickly, but estimates as to the probable spring rise must necessarily be empirical in character. In 1900 the high water at Portland, Oreg., was 17.8 feet on May 20. The snowfall that year was quite light over the entire drainage area. In 1901 the highest stage at Portland, during the spring rise, was 20.8 feet on June 3, and the snowfall was about the same as the year before, the higher water of 1901 being due to a backward spring. In 1902 the highest water at Portland was 20.8 feet on June 4, which is the same as the previous year, and it occurred on nearly the same date. The snowfall during the winter of 1901-02 was considerably heavier than during the preceding winter, and the spring was also backward. The reason that the water did not reach a higher stage is due to the fact that the melting of the snow was interrupted by several cool spells which checked the rise at high stages, and although the volume of water which passed out to sea was greater than in the previous year, the flood crest was no higher.

Many of those reporting the depth of snow in the mountains this year have stated the amount to be about the same as during the winter of 1898-99. The high water following at Portland that season was 24.2 feet on June 23. It is thought that with normal conditions during April and May the flood crest at Portland this year will reach a stage of 24 feet about the middle of June. Should the melting be rapid and continue

uninterruptedly the stage will be somewhat higher than 24 feet, but with marked cool spells intervening the stage will be a foot or two lower than the foregoing estimate. A stage of 24 feet at Portland necessitates a stage of about 43 feet at The Dalles, and 25 feet at Umatilla.

The ice was entirely out of the rivers by the 27th of the month, that in the Red River of the North being the last to go. In the upper Mississippi River the time of breaking up was a few days later than in 1902. No ice was reported below Keokuk, Iowa. Navigation for short trip boats was opened at Keokuk on the 16th, and at La Crosse, Wis., on the 21st.

The Penobscot River opened on the 12th, but running ice was reported as late as the 25th. The upper Merrimac and upper Connecticut opened about the 8th, and the ice passed down without causing any damage. The last ice in the Connecticut River reported was at Hartford, Conn., on the 10th.

The highest and lowest water, mean stage, and monthly range at 171 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Forecast Official.*

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Service Division.

The following summaries relating to the general weather and crop conditions during March are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon voluntary reports from meteorological observers and crop correspondents, of whom there are about 3000 and 14,000, respectively:

Alabama.—The first part of March was continuously wet, the latter part, until the rain of the 29th, being more favorable. Farm work was very much delayed, though considerable corn was planted in uplands, some corn being up before the 31st. Very little cotton was planted. Wheat and oats made very good progress. In northern districts peaches that escaped the February freeze were killed by frosts of 25-26th, but in southern sections fruit was only slightly injured.—*F. P. Chaffee.*

Arkansas.—Rains and high waters during the first half of the month delayed farm work; weather and condition of soil, except in overflowed districts, more favorable during last half, and rapid progress had been made in the uplands, but the lowlands were not in condition to work. Very little preparation made for cotton planting. Upland wheat better than usual; that in lowlands suffered considerable damage. Very few oats sown. Some Irish potatoes planted. Peach crop will be short, though not a total failure. There promised to be an abundance of apples and small fruits.—*Edward B. Richards.*

Arizona.—The temperature was considerably below normal in the northern division and slightly below normal in the southern and western divisions. Good rains fell during the month over most of the territory, but the heaviest rains occurred generally toward the close of the month, and irrigation canals were running full of water. The cool weather retarded the growth of vegetation somewhat, but the favorable conditions of moisture largely overcame the effect of cold weather, and crops generally were in a promising condition at the end of the month. Feed on the ranges was generally good, and cattle were in fair to good condition.—*M. E. Blystone.*

California.—The warm weather and well-distributed rainfall during the month were very beneficial to all growing crops, and there was little injury to young fruit by frost. Deciduous fruit trees were in full bloom at the close of the month and gave promise of a heavy yield. Wheat, barley, oats, and grass made rapid growth and were in excellent condition. The grain acreage is larger than usual.—*G. H. Willson.*

Colorado.—Season backward; soil in good condition and plowing general the last week of the month. Seeding wheat, oats, spring rye, barley, and alfalfa well advanced in southern counties. Fruit trees somewhat damaged by February freeze and some pruning necessary. Garden planting begun. Range poor but starting nicely. Outlook unusually favorable for good and prolonged flow of water in Rio Grande; from other watersheds early flow promised to be much better than last year's, but late flow less than usual, if not augmented by rainfall.—*F. H. Brandenburg.*

Florida.—Warm weather with frequent rains characterized the month. The excessive rains were more or less disastrous to the vegetable crop over the southern part of the State, where the yield of tomatoes will be

less than one-half of former years. The wet weather damaged or delayed all crops on lowlands. Much corn was replanted. On uplands the conditions were more favorable. Corn made fair progress and melons were doing well. Citrus trees and pineapples were very satisfactory.—*A. J. Mitchell.*

Georgia.—Prominent features of the month were high temperature, cloudiness, and frequent rains. There was a general absence of freezing temperature, the month, with one exception, was the warmest March since 1891. The precipitation in the northern sections was heavy, but in a few southwestern counties it was below the average. Excessive moisture proved detrimental to farm work, plowing for corn and cotton and the planting of these crops being much hindered. The peach crop was seriously damaged by the cold wave in February.—*J. B. Marbury.*

Idaho.—Weather conditions favorable for farm work prevailed during March, and the month was nearly normal as to temperature and precipitation. The winter weather was unfavorable for growth of grass on the stock ranges, but winter wheat was protected by snow and was in fine condition. There were heavy losses of sheep where not fed to hay and grain. The entire surplus hay crop has become exhausted. Fruit trees were in exceptionally healthy and vigorous condition.—*S. M. Blanford.*

Illinois.—In the northern district the weather was unseasonably warm, and the growth of grasses and meadows was greatly stimulated. Farm work was retarded on account of the soggy condition of the soil. The wheat crop in the central district was promising; in the southern district its condition was good, but somewhat uneven. Peach buds were seriously injured over the entire State, and probably killed in the central and northern districts.—*Wm. G. Burns.*

Indiana.—Wheat, rye, and clover were in excellent condition, except that a small acreage of wheat sown prior to September 25 showed effect of flies, and a small acreage was damaged by recent floods, and except, also, that clover was slightly injured in a few localities by alternate freezing and thawing. Plowing, sowing oats and clover, planting potatoes, and making gardens began.—*W. T. Blythe.*

Iowa.—The month was warm, with excess of cloudiness and fog, causing the frost to thaw rapidly. The saturated condition of the soil and lack of drying weather rendered field work impracticable except in very dry and sandy soil. Grass started early, and all fall sown crops came through the winter in excellent condition. Farm stock were generally thrifty.—*John R. Sage.*

Kansas.—A warm March, many fogs, and less wind than usual. Ground wet, retarding farm work. Wheat in good condition, an even stand, and growing well. Some oats sown. Rye doing well. Early peaches, apricots, and plums beginning to bloom in the south.—*T. B. Jennings.*

Kentucky.—Wheat was in excellent condition and very forward, and the outlook was decidedly promising. Winter oats and rye doing well. The sowing of spring oats progressing. Tobacco beds sown late on account of wet weather. Very poor prospect for peaches, many killed by freezes in February and latter part of March; hardy varieties will probably bear. Other fruits doing well. Grass in fine condition and stock doing well. Farm work much delayed by rain.—*H. B. Hersey.*

Louisiana.—Farming operations were materially interfered with by wet weather during the first and second decades of the month. More

favorable weather prevailed toward the close of the month and preparations for planting, which were much behind, were pushed vigorously. Several plantations suffered serious injury as a result of overflow. Cotton planting commenced toward the close of the month, but progressed very slowly. Corn planting was materially retarded. Wet weather interfered with cane planting and damaged seed cane. Fall plant and stubble cane were generally in good condition. Rice seeding was much behind. Truck gardens backward.—*I. M. Cline.*

Maryland and Delaware.—A warm and rainy month. Heavy rains delayed plowing, although fair advance was made on the uplands. The prevailing warmth produced luxuriant growth in wheat, rye, and grasses, but some damage was done to lowland wheat by water. Some oats were sown in all districts. Old meadows and fall sown grasses were thin, but spring sown clover did well. Lettuce, onions, radishes, and early potatoes were planted in many localities. A large acreage of canning peas had been sown and some were up. Peaches, plums, and strawberries were blooming in the southern counties. Tobacco beds were made and the early plants were showing.—*Oliver L. Fussig.*

Michigan.—Abnormally warm, with moderate precipitation during March, was very favorable to winter wheat and rye, which at the close of the month was in generally good and promising condition, but fruit buds had been forced and some peach damage was reported. Plowing was becoming general in many counties of the lower peninsula and some oats and clover had been sown.—*C. F. Schneider.*

Minnesota.—The precipitation was light and scattered, except from about the 15th to the 23d, during which period most of the month's precipitation occurred. There were both rain and snow during the month. The soil was frozen early in the month, but the frost came out of the ground in southern portions late in the month, leaving the soil wet. No preparation of the soil, or seeding, was possible except on a few knolls on the 30th or 31st.—*T. S. Outram.*

Mississippi.—The first three weeks were warm, cloudy, and rainy, and as a result farm work was much retarded. The last decade was fair and cool, and very favorable for farming operations, which were becoming general, except in the flooded districts. Oats were doing finely. Corn planting was begun on uplands. Vegetable crops were quite as forward as usual, although slightly damaged by frost on the 25th and 26th. Fruit prospects were poor north, but fair south.—*W. S. Belden.*

Missouri.—Although March was warmer than usual, in most sections of the State the soil continued so wet that but little progress could be made with farm work, and except in a few of the southern counties oat sowing had only fairly begun at the close of the month. The weather was exceptionally favorable for the wheat crop, which was generally reported as in a very promising condition and making a vigorous growth.—*A. E. Hackett.*

Montana.—In the greater part of Yellowstone and Rosebud counties and in the valleys on the west side of the Main Divide the weather was rather warm, but periods of cold weather were of frequent occurrence in other parts of the State, especially in Choteau, Valley, and Dawson counties. The precipitation was light in Valley and Dawson counties, along the southern border of the State as far west as Park County, and in Granite and southern Powell counties; in other portions of the State it was fairly copious. On March 31 the frost was out of the ground in but few localities and very little progress had been made with farm work. All stock improving.—*Montrose W. Hayes.*

Nebraska.—The first three weeks were warm, but the last ten days were unseasonably cold; the soil was wet from the heavy snows of February and generally was not in good condition to work until the last of the month; therefore very little work was done in March. Winter wheat and rye started nicely and generally were in unusually good condition at the end of the month.—*G. A. Loveland.*

Nevada.—The temperature was about normal and the precipitation above the average and fairly well distributed. Heavy snow fell in western portion on 31st. Plowing and seeding in progress toward close of month. Rains in the latter part of the month started grass to growing nicely. Season somewhat backward.—*J. H. Smith.*

New England.—March was unusually mild and very favorable for outdoor work. Grass, grain, and fruit, except peaches, wintered well; peaches were injured by the extreme cold weather in December. Plowing was begun in all sections and in some places garden seeds have been planted. The maple sugar yield was exceedingly light and of very poor quality. At the close of the month the season was from two to four weeks in advance of the average.—*J. W. Smith.*

New Jersey.—March, 1903, was exceptionally mild, the average temperature being the highest on record for that month, and was noted for the absence of high winds, snow, and frosts. In the southern part of the State plowing, planting, seeding of oats, and planting of early truck were well advanced, but in the central and northern portions the ground was too wet for plowing. Winter grain, clover, and grass made rapid growth, and at the end of the month were in fine condition, except on low fields, where considerable winter killing occurred. All early orchards and small fruits were so far advanced at the close of the month as to be exposed to injury from frost.—*Edward W. McGann.*

New Mexico.—Altogether March was a favorable month, except in parts of Lincoln County, where there was much suffering from drought. By

the close of the month plowing was well begun, and some wheat sown in warmer sections.—*R. M. Harding.*

New York.—Snow disappeared and frost was out of the ground early in March; season about three weeks ahead of normal; weather very favorable for wheat, rye, meadows, and pastures. Fruit trees wintered well, but buds advanced to dangerous degree by reason of unseasonably warm weather; plowing begun but delayed by rains; very small crop of maple sugar.—*R. G. Allen.*

North Carolina.—The temperature was above normal the entire month, and the mean for the month was the highest on record. Killing frosts occurred on the 2d, after which no further frost occurred until the 26th and 27th, the latter without injury to vegetation. Before the end of the month fruit trees were generally in bloom and many forest trees in leaf. The excessive rainfall prevented much farm work and very little plowing was accomplished. Wheat, oats, and rye grew well. Truck crops and strawberries were unusually well advanced by the close of the month.—*C. F. von Herrmann.*

North Dakota.—Mild weather with less than the usual amount of snowfall prevailed during the month. No farming operations were carried on, the ground being frozen during the entire month.—*B. H. Bronson.*

Ohio.—The mean temperature was nearly 2° higher than ever before recorded. Winter grain, grass fields, and pastures started very rapidly with the warm weather. Fruit buds came out rapidly and early fruits were in bloom in many southern sections by the end of the month. Plowing was under way, some oats sown, and some potatoes planted in southern counties. There was very little snowfall. The weather was very unfavorable for maple sugar making.—*J. Warren Smith.*

Oklahoma and Indian Territories.—Wet, cold soil prevented the progress of farm work, especially over Indian Territory, where but few oats and potatoes were planted. In Oklahoma, the conditions were more favorable and farm work was more advanced, oats and potatoes being mostly planted and the early sown oats coming up to a fair stand; wheat was generally in a fair condition and making good growth; grass was starting and stock was doing fairly well; rye, alfalfa, and volunteer oats were in good condition; fruit trees were damaged by the cold periods, but generally, the conditions were promising; peach, apricot, and plum trees were blooming.—*Chas. A. Hyle.*

Oregon.—Fall sown wheat came through the winter better than was expected earlier in the season, and but little reseeding will have to be done. The fall sown acreage, however, is much smaller than the previous year, and more than the usual amount of spring wheat will have to be sown to make up the deficiency. Fruit trees wintered well and some early varieties were in bloom at the close of the month. Stock continued poor on account of the shortage of pasturage.—*Edward A. Beals.*

Pennsylvania.—The mean temperature exceeded the normal by 10.4° and was the highest of record for the month of March. The precipitation was about 0.75 inch above the average, the snowfall being exceedingly light. At the end of the month the season was from two to four weeks forward, plowing and seeding were in progress, and fruits so far advanced as to be exposed to injury by frosts.—*H. A. McNally.*

Porto Rico.—Weather generally was quite dry and in the southern parts of the island the drought was very severe. All farming operations, excepting sugar making, at a standstill, awaiting rain. Sugar making was carried on continuously throughout the month with fairly satisfactory results. Young canes generally needing rain, especially the young ratoons. Tobacco cutting has been quite active and the yield very good; crop about harvested. Flowering of coffee trees backward and irregular. Other fruit trees blossoming. Small crops and pasturage becoming scarce.—*E. C. Thompson.*

South Carolina.—High temperatures, excessive precipitation, and general absence of killing frost made the month a noteworthy one. Vegetation grew rapidly. Farm work made slow progress. Planting operations were confined to the uplands of the eastern half of the State, where much corn, some cotton, rice, cane, tobacco, gardens, and minor crops were planted. Fruit prospects generally good. Wheat promising, but oats were destroyed to a large extent by a grain aphid over the eastern and central counties.—*J. W. Bauer.*

South Dakota.—The weather averaged somewhat warmer than usual and the precipitation was sufficient to insure ample moisture for early field work, but no seeding and but little preparatory work was done, due to the fields being too wet in the southern portion of the State and insufficient warmth elsewhere to free the soil of frost. Winter rye came through the winter in very favorable condition. Snow and cold rain in the second decade caused some slight loss of weak live stock on the ranges.—*S. W. Glenn.*

Tennessee.—Temperature and rainfall above normal; heavy rains in many sections and cloudy weather delayed plowing, and but little planting was done until latter days of the month; Irish potatoes were being planted and some gardening done; very little corn planted; tobacco beds all sown; wheat and other winter grains in fine condition generally and further advanced than usual, prospects better than for years at this period; late frosts did little or no damage, except to early fruits; planting spring oats delayed; clover and grass looking well.—*H. C. Bate.*

Texas.—Over the southwestern portion of the State the temperature was considerably below normal for the month, but elsewhere was very nearly the average. There was less than the usual amount of precipita-

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings:

Summary of temperature and precipitation by sections, March, 1903.

Section.	Temperature—in degrees Fahrenheit.								Precipitation—in inches and hundredths.						
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.		
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.	
Alabama	59.4	+ 4.2	Bermuda	85	20	Riverton	26	25	5.91	+0.11	Maple Grove	8.83	Greenville	3.62	
Arizona	54.2	- 0.8	Agua Caliente, Cochise.	95	29	Fort Defiance	3	1	1.16	+0.54	Flagstaff	3.77	Aztec, Yuma	T.	
Arkansas	54.8	+ 3.2	Ozark	85	7	Pond	11	1	5.56	+0.22	Mossville	8.37	Pond	3.29	
California	50.9	- 1.6	Imperial	104	9	Bodie	-21	7	5.80	+2.70	Pilot Creek	19.39	Volcano	0.00	
Colorado	33.7	- 0.4	Lamar	89	31	Wagon Wheel Gap	-35	1	1.09	-0.40	Telluride	8.61	Vilas	T.	
Florida	69.1	+ 3.7	Tarpon Springs	91	3	Holt	35	25	5.52	+2.44	Jupiter	9.27	Jacksonville	2.55	
Georgia	60.4	+ 5.2	Orange City	81	21	Molino	35	26	6.74	+1.43	Clayton	14.81	Morgan	3.34	
Idaho	34.9	+ 0.2	Jesup	88	20	Clayton	2	2	1.68	+0.07	Grangeville	4.29	Chesterfield	0.48	
Illinois	45.3	+ 6.4	Garnet	79	30	Chesterfield	-27	1	2.96	-0.16	New Burnside	6.29	Hoopeston	0.64	
Indiana	46.7	+ 7.1	7 stations	17-19		Kishwaukee	9	1	2.95	-1.03	Scottsburg	6.71	Veedersburg	0.87	
Iowa	38.8	+ 6.6	Avoca	81	18	Delphi	12	1	1.38	-0.53	Le Mars	3.90	Denison, Ruthven	0.15	
Kansas	43.5	+ 2.1	Mount Pleasant	87	17	Baxter, Clear Lake	6	1	1.54	+0.01	Columbus	5.87	Ness City	0.10	
Kentucky	52.5	+ 5.9	Meade	85	18	Viroqua	-15	1	4.43	-0.74	Alpha	6.83	Fords Ferry	2.55	
Louisiana	61.9	+ 1.8	Pikeville	85	19	Loretto	19	2	8.39	+3.80	Clinton	21.47	Shreveport	2.89	
Maryland and Delaware	49.3	+ 8.1	Richmond	89	7	Plain Dealing	29	1	2.56	+1.36	Bachmans Valley, Md.	9.36	Green Sulphur Springs, Md.	3.00	
Michigan	37.4	+ 9.4	Shriever	89	9, 19	Ruston	29	25	1.86	-0.67	Detour	5.07	Owosso	0.20	
Minnesota	29.6	+ 4.7	Donaldsonville	89	20	Grantville, Md.	15	2	1.75	+0.44	Grand Meadow	3.62	Mount Iron	0.48	
Mississippi	60.0	+ 3.3	Boettcherville, Md.	85	18, 19	Ironwood	-4	1	6.47	+0.88	Woodville	14.98	Hernando	2.98	
Missouri	46.8	+ 4.8	Adrian	86	10	Ripley	27	25	3.34	0.00	Lamar	8.63	Conception	0.85	
Montana	27.0	- 1.6	Duck Hill	81	17	Warrenton	9	1	0.95	-0.09	Summit	6.85	Livingston	0.01	
Nebraska	35.8	+ 1.6	Jefferson City, New Haven.	70	24	Culbertson	-18	20	0.72	-0.43	Genoa	2.17	2 stations	T.	
Nevada	38.7	- 0.1	Troy	70	30	Agate	-11	20	1.41	+0.35	Beowawe	5.36	Hawthorne	T.	
New England	40.8	+ 9.8	Miles City	89	31	Potts	-8	18	5.95	+2.43	Bar Harbor, Me.	10.05	Chatham, N. H.	2.95	
New Jersey	47.6	+ 8.9	Fort Robinson	90	30	Fort Fairfield, Me.	-17	3	5.13	-1.00	Woodbine	8.53	Pemberton	3.60	
New Mexico	43.3	- 0.4	Rioville	89	20	Ringwood	13	2	0.48	-0.01	Taos	1.40	4 stations	T.	
New York	41.4	+10.8	Indian Mills.	79	20	Waxsors	-17	1	4.59	+1.60	Cuthogue	7.51	Yongstown	2.27	
North Carolina	56.1	+ 7.5	Carlsbad	81	13	Axton	-1	3	7.48	+2.87	Highlands	17.52	Currituck Inlet	2.13	
North Dakota	22.1	+ 4.5	Fayetteville	83	20	McKinney	-24	20	0.55	-0.39	Hamilton	1.58	2 stations	T.	
Ohio	46.7	+ 7.8	Coal Harbor	85	19	Hudson	11	2	3.51	+0.22	Coalton	6.10	Findlay	1.62	
Oklahoma and Indian Territories	49.8	+ 0.1	Portsmouth.	85	19	Kenton, Okla.	-13	1	2.73	+0.50	Goodwater, Ind. T.	6.01	Kenton, Okla.	0.10	
Oregon	42.6	- 0.3	Clifton, Okla.	90	31	Joseph	-2	8	4.09	-0.26	Glenora	14.93	Umatilla	0.28	
Pennsylvania	46.4	+10.4	Grants Pass	78	22	Dyberry	14	2	4.52	+0.67	Pottsville	5.81	Erie	2.82	
Porto Rico	74.2	- 0.1	California	83	18	Adjuntas	44	13	2.34	-0.64	Moravia	6.13	Camo	T.	
South Carolina	60.4	+ 5.9	Manati	93	28	Clemson College	26	1	5.92	+2.16	Batesburg	11.14	Bowman	1.53	
South Dakota	31.4	+ 2.9	Yemassee	84	21	Pedro	-15	20, 24	1.18	-0.20	Spearfish	3.98	2 stations	0.20	
Tennessee	54.9	+ 6.2	Chamberlain	77	31	Rugby	18	2	5.77	-0.08	Decatur	12.12	Waynesboro	3.44	
Texas	57.4	- 1.5	Liberty	83	19	Amarillo	-2	1	3.21	+0.53	Rockport	11.21	3 stations	T.	
Utah	37.3	- 0.3	Camp Eagle Pass, Fort McIntosh.	93	31	Woodruff	-32	1	1.19	-0.34	Kanab	5.55	Green River	0.02	
Virginia	51.8	+ 6.7	St. George	80	30	Burkes Garden	16	2	5.79	+2.06	Callville	9.85	Stephens City	3.63	
Washington	40.0	- 1.9	Barboursville	81	15	Conconully	-2	12	3.45	+0.38	Brinnon	10.72	2 stations	0.25	
West Virginia	51.3	+ 8.6	Mottingers Ranch	78	24	Nuttallburg	13	2	4.47	+0.54	Dayton	6.59	Old Fields	2.70	
Wisconsin	36.6	+ 8.6	Byrne	87	20	Travellers Repose	13	8	2.34	+0.56	Green Bay	3.75	Hayward	0.82	
Wyoming	29.2	+ 0.2	Charleston	87	20	Hayward	-8	8	0.94	-0.36	South Pass City	2.60	Basin	T.	
			Milwaukee	75	18	Border	-33	1							
			Prairie du Chien	75	19										
			Basin	72	28										

tion, except along the Gulf coast, where the rainfall was very heavy. Killing frosts occurred on the 1st very generally, except in the coast district and the southeastern counties, and on several dates during the last decade in the northern counties, doing serious injury to the fruit crop, especially peaches. Owing to the wet condition of the soil farm work made slow progress prior to the last decade, when it advanced very rapidly, and cotton planting was begun in the northern and was general in the central and southern portions of the State; corn planting was practically completed and coming up, except in the northern portion, to fairly satisfactory stands; planting of sugar cane in progress and gardening completed. At the close of the month wheat, rye, and oats were in fine condition, grass was growing very fast and beginning to afford excellent pasturage.—Don V. Burney.

Utah.—Farm work during the month was generally limited to plowing, which began during the last decade. Fall grain and alfalfa made a good start. The fruit buds passed through the winter without suffering damage, but were showing no signs of opening at the close of the month. The grass has started on the ranges, but feed was scarce and stock generally in poor condition.—L. H. Murdoch.

Virginia.—The weather of the month was unusually favorable for crop growth, but on account of excessive precipitation field work was retarded. Fall sown wheat and oats came through the month in fine condition, especially in the valley section, where locally the growth was from 8 to 10 inches. Spring oats were seeded, came up, and were doing well at the close of the month. A plentiful supply of tobacco plants. Fruit trees blooming heavily.—Edward A. Evans.

Washington.—Month cool and, on the whole, unfavorable for growth and development of staple crops. The ground was frozen so much of the time and snow continued so late that spring seeding and plowing

were scarcely under way until the last week. The fruit buds were not developed, which has probably saved them from frost and cold rains. There was some slight damage to winter wheat by freezing, but it was generally in good condition. The spring is three weeks late.—G. N. Salisbury.

West Virginia.—Mild weather prevailed during March, and, at the close of the month, wheat, rye, and oats were in much better condition than usual at this time of the year; grass was making rapid growth, and some stock had been turned out to pasture; considerable plowing had been done, some oats and potatoes seeded, and some gardens made; fruit buds were swelling, but little damage was done by the frost of the last week.—E. C. Vose.

Wisconsin.—The month was unusually warm, and vegetation made an excellent start, especially in the southern portion of the State. Wheat and rye suffered but little from winter killing, and clover appeared to have sustained less injury than usual. Considerable plowing and seeding was done during the latter part of the month.—W. M. Wilson.

Wyoming.—The only severe storm of the month was on the 18th, when heavy snow was quite general over the State, yet some sections received very little snow then; the storm was followed by a moderate cold wave. The spring is backward. Stock losses have been heavy in some sections, and only normal in other sections.—W. S. Palmer.

SNOWFALL AND WATER SUPPLY IN THE ROCKY MOUNTAIN REGION.

The following extracts are taken from the snow bulletins for February, 1903, prepared by the Section Directors of Climate and Crop sections in the Rocky Mountain region:

Colorado.—March was not so stormy as usual over the greater part of the mountain region, and, taken as a whole, the precipitation was below normal, although local excesses were noted in nearly every watershed. Considerable snow has melted in the valleys, and a large proportion of the moisture is being absorbed by the dry soil. Above 9000 feet the depths are practically the same as a month ago, the current fall generally making good the loss in depth by the gradual settling of the old snow, much of which is in a condition to remain late in the season. The outlook for a good and prolonged flow is unusually favorable for the Rio Grande; on other watersheds the early flow promises to be much better than last year's, but the late flow will be less than normal if not augmented by rainfall.

Idaho.—At the close of March the measurements showed that the amounts on the ground were in excess of the average in nearly all sections. With a few localities excepted, an abundance of water for irrigation is assured.

Montana.—On March 31 the prospects for a good flow of water, which, from present indications, will last until late in the season, were very favorable throughout the greater portion of the State. There are some localities in which the snowfall has been below the average, or in which the snow is not drifted or firm, and somewhat less than a normal waterflow is anticipated; however, they comprise a small portion of the State.

Nevada.—The depth of snow in the mountain ranges on March 31, 1903, was very much greater than it was at the close of the corresponding month last year. There was but little or no loss of snow from melting on account of the low day and night temperatures which prevailed during February and the greater part of March. Indications are favorable for plenty of irrigation water in all districts the coming summer.

New Mexico.—At the close of March the snow had all melted in the lower valleys, but there were some patches on northern sides of the lower mountains. On the higher ranges, at the headwaters of the Canadian, Pecos, and the New Mexico streams tributary to the Rio Grande, the depth of unmelted snow ranged from 3 to 6 feet, with the deep canyons of the northern sides filled with hard packed snow, thus insuring a

lasting and steady supply for the upper valleys of these streams far into the summer. On the summits of the White and Sacramento mountains the greatest depth was probably about 5 feet, with the canyons well filled; and about the same conditions obtained at the headwaters of the Gila and San Francisco rivers. Throughout the southwestern sections, at the lower altitudes, rains during the latter part of March and the 1st of April, rapidly melted the snow, in some cases causing damaging flood waters. Throughout the territory the soil was in an unusually moist condition, with the streams running bank full and a steady supply to draw on.

Utah.—The precipitation during the month was about normal. The depth of snow in the mountains of all the watersheds of the State is generally greater than usual and exceeds that for any season since the winter of 1896-97. Most of the snow fell during November, December, and January. It has therefore had plenty of time to drift and pack, and is now in splendid condition to withstand the warm weather. The temperature conditions during March were about normal, and only a moderate amount of melting occurred. The depth of snow and its drifted and well packed condition assure all sections of the State an abundant supply of irrigation water throughout the coming crop season.

Wyoming.—The March snowfall was in excess of the normal throughout most of the State, thus adding to the supply of snow which will be available for irrigation during the coming summer. The outlook for water for late summer irrigation is more favorable than it has been at this season of the year since the spring of 1899. The late snows over the eastern slope of the Big Horn Mountains has brought the supply in that section up to or above the normal, and streams of that section should carry more water the coming season than during the past three seasons. The southern half of the State has a good supply of snow in the mountains, the depths being greater than usual over almost every section and excessive in many sections. This assures a good water supply for the coming summer over the Laramie, Platte, Green, and Snake River watersheds, even though the late spring snowfall should be deficient and the early summer unusually warm.

SPECIAL CONTRIBUTIONS.

CLIMATOLOGY OF THE ISTHMUS OF PANAMA.

By General HENRY L. ABBOT.

Since it now appears probable that the Government of the United States will soon begin operations to complete a ship canal connecting the waters of the Atlantic and Pacific oceans by cutting through the Isthmus of Panama, public attention can not fail to be attracted to the region in question, where for more than twenty years two private companies have successively been engaged in prosecuting the work under serious difficulties both financial and climatic. During this long period they have collected much valuable data respecting the climate which, tropical in character and differing widely from any in the United States, deserves to be carefully studied in advance by parties proposing to take an active part in the great work. Certain portions of this information have already appeared in the MONTHLY WEATHER REVIEW, but in view of present conditions it has seemed to me desirable to prepare a summary bringing these records up to date, with an analysis designed to develop the information they convey. This is attempted in the following paper.

MONTHLY VARIATIONS IN TEMPERATURE.

In considering the climate of the Isthmus, as compared with that of more temperate regions, attention is attracted by the remarkable uniformity of temperature throughout the year. This is illustrated in Table 1, chiefly extracted from Bulletin No. 22 (serial No. 163), of the United States Weather Bureau, published in 1898.

The general elements which determine this uniformity are the direct heat received from the sun; the influence of the excessive volume of aqueous vapor held in suspension in the atmosphere; the influence of the two great seas which wash the shores of the narrow belt of land constituting the Isthmus. The influence of the seas depends on their varying absolute temperatures and on the movements of the atmosphere, as these, in a large measure, regulate the effect of the oceans in different months. The available statistics, collected chiefly by the two Panama Canal companies, throw much light upon the relative influence of these several agencies, and are sufficiently

complete to warrant an attempt at a mathematical study of the problem, with a view to a thorough understanding of the climate. Each element will be considered in turn.

TABLE 1.

Localities.	Approximate latitude.	Years of observation.	Average temperature.				Max. recorded.
			Annual.	Hottest month.	Coldest month.	Difference.	
Washington	39	25	54.7	76.9	33.2	43.7	104
New Orleans	30	25	68.8	82.4	53.3	29.1	99
Key West	25	21	77.5	84.4	70.5	13.9	.....
Assuan or Wadi Halfa	23	.....	80.0	94.8	64.0	30.8	119
Habana	23	10	76.8	82.4	70.3	12.1	101
San Juan, P. R.	18	12	78.8	81.5	75.7	5.8	101
Kingston, Jamaica	18	10	78.1	81.1	74.6	6.5	.....
Barbados	13	20	75.6	76.9	73.4	3.5	.....
Cayenne	4	1	79.7	82.0	77.1	4.9	.....
Manila	15	17	80.0	84.0	77.0	7.0	100
Isthmus of Panama	9	26	79.7	81.0	78.3	2.7	99

Monthly mean temperatures, as determined from hourly observations, refer to the middle of each month. Hence, the relative intensity of the solar energy received during the month may be regarded as proportional to the sine of the altitude of the sun at noon, and its relative duration as proportional to the length of the time that it is above the horizon on that day. In latitude 9° north, the sun at noon is at the zenith twice during the year, once on April 13 when it is journeying northward to reach its summer solstice on June 21, and again on August 29, when returning toward its winter solstice, which it reaches on December 21. The direct heat transmitted at these altitudes is then proportional to the sines of 90°, 75° 41', and 57° 24', or to the numbers 1.00, 0.97, and 0.84 for the zenith, the summer solstice, and the winter solstice, respectively. It is, however, to be noted that the length of day, and hence the duration of solar radiation, attains its maximum in June and its minimum in December; and that this element therefore tends to reduce the natural fall of temperature during the northward journey of the sun, and to augment it dur-